Improving Garden Soil Fertility

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Fresh vegetables are an excellent source of the vitamins and minerals essential to good health. A garden soil well supplied with organic matter and needed minerals will, under favorable conditions, produce a good yield of vegetables which are high in quality and nutritional value.

In order to use commercial fertilizers to best advantage, the organic content of soils must be maintained at a high level. Adding some form of organic matter to the soil each year is a good garden practice. In addition to the use of animal manure to add organic matter, any composted plant material such as leaves, cotton burrs, hay, or straw will do. Composted materials can either be spread on, mixed with the soil, or used as a mulch around growing crops.

Since organic matter is not a balanced fertilizer, use a commercial fertilizer, such as 12-24-12, at the rate of two to four pounds per 100-foot row. The fertilizer should be mixed with the soil to prevent damage to seeds or roots of the young plants.

Many people ask if it is possible and practical to substitute organic materials—animal manures, compost, and various plant wastes—for commercial fertilizer. It may be possible in some cases. The answer in each case depends on the particular soil under consideration. Different soils have different needs.

Research has shown that for efficient production of high quality plants:

- Many soils produce best when they are given *both* organic and commercial fertilizers.
- Some soils need only organic matter; for others, commercial fertilizers meet all requirements.
- Only a few soils have adequate quantities of humus and available plant nutrients so that they can produce good plant growth over a long period without amendments.
- The right kinds and amounts of commercial fertilizers, properly used, will increase plant growth in most soils—including growth of roots and stubble that contribute to the supply of soil organic matter.

Plant Soil Needs

For good growth, the plant must have space in the soil to get air; room to grow roots; suitable soil acidity or alkalinity; and adequate water, sunlight, and mineral nutrients. Air space, root room, and water available to a plant depend largely on the soil structure. This, in turn, is closely related to the organic matter in the soil and a suitable distribution of mineral particles of different sizes to keep the soil open and porous, permit excess water to drain away, and air to enter.

The plant absorbs mineral elements and water from the soil and carbon dioxide gas from the air. The elements most frequently deficient include those normally present in commercial fertilizers—nitrogen, phosphorus, and potassium. Another important nutrient element—calcium—is added in commercial fertilizers and more particularly in agricultural lime that also serves as a neutralizing agent. Other elements that may be deficient in some soils for some crops include magnesium, boron, manganese, copper, zinc, iron, molybdenum, and sulfur.

All soils, even those never cultivated, differ widely in their content of plant nutrients. Soils lose available nutrients through erosion, leaching or washing out, and the harvesting of crops. Some of these losses are regained through the weathering of minerals, rainfall, the action of soil organisms from subsoil with or without erosion, and by the upward movement of ground water.

Deficiencies of plant nutrients in soil must be corrected if the soil is to produce adequately. Fertilizers and manures are added for this reason and also to increase plant growth on soils already fairly well supplied with essential nutrients.

Organic Matter Aids Soil Structures

Animal and vegetable matter decomposes to form humus—a dark brown or black substance. Humus is extremely important to the successful growth of plants of all kinds be-

Lime Requirements of Various Soil Types

Existing pH of Soil	Pounds of Agricultural Limestone Needed per 100 sq. ft. to Raise:					
	Sandy Loam Soil		*Silt Loam Soil*		*Silty-Clay Loam Soil*	
	to pH 6.0	to pH 6.5	to pH 6.0	to pH 6.5	to pH 6.0	to pH 6.5
6.0	0.0	2.0	0.0	4.0	0.0	5.0
5.5	2.0	4.0	4.0	7.0	5.0	10.0
5.0	4.0	6.0	7.0	11.0	10.0	15.0
4.8	4.5	7.0	8.0	12.0	12.0	17.0

Sulfur Requirements of Various Soil Types

Existing pH of Soil	Amount of Sulfur (95% S) Needed to Lower the Soil pH to pH 6.5: (Weight is in Pounds per 100 sq. ft.)		
	Broadcast Application (then mixed in soil to a depth of 6 inches)		
	Sandy Soils	*Loamy Soils*	*Clay Soils*
7.5	1.0-1.5	1.5-2.0	2.0-2.5
8.0	2.5-3.0	3.0-4.0	4.0-5.0
8.5	4.0-5.0	5.0-6.0	6.0-7.5
9.0	5.0-7.5	-----	-----

Source: *The Fertilizer Handbook.*

cause it tends to promote a more favorable soil structure. When a sod cover remains on the soil for two or more years, the soil is greatly improved both by the organic residue and the fibrous root system. Humus increases the water-holding capacity of the soil, lessens erosion, decreases the loss of valuable minerals by leaching, and makes the soil easier to cultivate.

Adding organic matter to the soil can:

- Make a heavy soil lighter, more crumbly, and friable. This is especially important in areas where the soil is high in clay.
- Hold light soil particles together and help anchor them against erosion. This increases the water-holding capacity of soil in sandy areas.
- Provide some of the nitrogen needed by plants.
- Release nutrients already in the soil by turning them into soluble compounds that can be absorbed by the roots of the plants.
- Permit growth and functioning of micro-organisms.
- Furnish a small quantity of all elements essential for plant growth.

The addition of organic matter to the soil *does not* reduce infestation of weeds, diminish plant diseases, nor protect crops from insect attack. Nor does it have any marked influence on the vitamin content of crops grown in the soil.

Commercial Fertilizers Supply Nutrients

The great importance of commercial fertilizers to plant growth and crop production lies in the fact that they furnish usable amounts of three primary elements for plant nutrition—nitrogen (N), phosphorus (P), and potassium (K).

The numbers (referred to as the analysis) on the tag or across the front of the fertilizer bag represent the percentages of N (nitrogen), P (phosphoric acid) and K (potash). Thus, a fertilizer with the analysis of 12-24-12 would contain 12 percent nitrogen, 24 percent phosphorus as P_2O_5, and 12 percent potash as K_2O. These materials may also supply some of the other elements essential for the growth of healthy plants.

A fertilizer material containing some percent of each of the three main nutrients is referred to as a "complete fertilizer." If one of the materials is not present, as in an analysis of 15-20-0, the fertilizer is referred to as an "incomplete fertilizer." Sometimes a greater concentration of one particular element is desired. For example, eastern Oklahoma gardeners may need to select a fertilizer with a greater concentration of phosphorus, such as 10-52-17, or a phosphorus only supplement, such as 0-20-0.

The chemicals are processed by the manufacturer into forms suitable for plant use. The plant nutrients in the fertilizers are the same as those obtained from the soil and from organic matter by soil organism activities.

From humus, for example, organic nitrogen may be converted to nitric acid, which in turn combines with lime and other bases of the soil to make a salt—calcium nitrate. This can be used by the plant. This is exactly the same chemical as the calcium nitrate that may be present in commercial fertilizer. The factory does in a few hours the job nature takes months and years to accomplish.

Where needed, commercial fertilizers increase production of good quality crops. These, in turn, leave increased plant residues in the soil to improve the structure and provide food for soil organisms. This is the way that commercial fertilizers not only supply nutrients for the crop, but also increase the supply of soil organic matter to improve the soil. This makes it possible to produce large quantities of quality crops in many areas where it would otherwise be impossible.

N-P-K and Plant Growth

N (nitrogen) is needed for the development of dark, green color in plants. It is essential for rapid and continuous vegetative growth.

P (phosphorus) aids plants in getting off to a rapid, vigorous start, promotes early root formation, stimulates blooming and seed production, and hastens maturity.

K (potassium or potash) is needed for plant health and disease resistance. It is important in ripening of fruit and helps to develop full, plump seeds.

Where needed and applied in required amounts, commercial fertilizers *do not* injure the soil. They *do not* poison vegetables or other plant growth. They *do not* destroy animal life—earthworms or bacteria—in the soil. On the contrary, the addition of fertilizer provides both plant and animal life in the soil with nutrients essential to their welfare.

Correcting Soil pH

The measure of the acidity or alkalinity of soil is referred to as the soil pH and is determined by a soil test. (Information on procedures for having your soil tested can be obtained from your county Extension office.) If the soil test shows the soil is too acidic, lime can be used to bring the soil into an optimum pH range. If the soil is too alkaline, sulfur is used to reduce the alkalinity. On the pH scale, soil that is neutral will have a reading of 7.0. Readings below 7.0 indicate the soil is acidic, while those reading above 7.0 indicate an alkaline condition. Vegetable crops, as a group, prefer a slightly acidic soil of about 6.5 pH.

The charts on page 2 will serve as a guide as to how much lime or sulfur must be used to correct the soil pH.

Starting with a Soil Test

The soil test provides a starting place for a soil improvement program for the home gardener. Unless you know the problems in your garden soil, you are only guessing when you apply fertilizer. Check with your County Extension Director or horticultural specialist at the county Extension office for soil testing information. The Extension office is generally located in the county courthouse and the phone number is listed with other county offices.

Use a soil probe, spade, or shovel to sample the soil profile to a depth of 8 to 12 inches. It is important to obtain a representative sample of the soil in the root zone rather than only the surface soil.

It is generally advisable to take several samples (at least 10) around your garden area, and then mix these thoroughly in a clean bucket or pail. This gives a representative sample of the entire garden area.

From the bucket or pail, select about a pint of soil. Special soil sample containers are available from your county Extension office or fertilizer supplier. You may also use a clean milk carton, ice cream container, or similar package. Make sure the container is clean and labeled with your name, address, and information on the garden crops to be grown. If you send more than one sample, be sure to clearly label each.

If you suspect a particular area in your garden is extremely different than the rest, or if you have a problem area, include that area as a separate sample. Be sure to label the sample as such.

Your County Extension Director will send the sample to the Oklahoma State University soil testing laboratory. Recommendations will be made on the amounts of fertilizer to use on your garden area.

It is important that fertilizers be used in correct amounts and that they be applied in the proper manner. If soil test recommendations are given in number of pounds per acre, the following tables may be used to convert per acre amounts to garden use.

Fertilizer Placement

For hill and row applications, the fertilizer should be placed an inch or two below the depth of the seed and about three

Broadcast Application

To Broadcast Fertilizer on a 100-Square Foot Area

Recommended Pounds per Acre	*Use/100 Square Feet*
110	1/4 lb. or 1/4 pt.
220	1/2 lb. or 1/2 pt.
435	1 lb. or 1 pt.
870	2 lbs. or 1 qt.

To Apply Fertilizer to Plants in Hills

Hill Spacing	*3'x5'*	*5'+ - 8'*	*Amount/Hill*
Recommended	363	136	1/8 lb. or 1/4 cup
Lbs. per Acre	725	272	1/4 lbs. or 1/4 pt.
	1,450	544	1/2 lb. or 1/2 pt.

To Apply Fertilizer to 100-Foot Rows

Recommended Pounds per Acre		
3-Foot Width	*1 1/2-Foot Width*	*Use per 100-Foot Row*
75	150	1/2 lb. or 1/2 pt.
150	300	1 lb. or 1 pt.
225	450	1 1/2 lbs. or 1 1/2 pt.
300	600	2 lbs. or 1 qt.
450	900	3 lbs. or 1 1/2 qts.
600	1,200	4 lbs. or 2 qts.

inches to either side. It should not come in direct contact with the seed or plant root system. When heavy applications (more than 600 pounds per acre) of chemical fertilizer are needed, half of the amount should be plowed or spaded in during soil preparation. The other half may be placed in the hills or rows at planting or transplanting time, as the case may be.

For broadcast application the fertilizer material should be scattered evenly over the entire garden area and spaded or tilled into the soil before planting.

Starter Solutions

When transplanting such plants as tomatoes, peppers, egg plants, or cabbage into the garden, the use of a starter solution will provide a supply of available nutrients to the young plants to aid in getting them off to a fast start.

Starter solutions can be purchased at local nurseries or garden centers, or you can make your own by adding two tablespoonfuls of a commercial fertilizer such as 18-46-0, 12-24-12, 10-20-10, or similar material to a gallon of water and mixing well. Apply about one cup of this solution to each plant as it is set in the garden.

Side Dressing

Ammonia nitrate, ammonia sulfate, or other forms of nitrogen may be used as a side dressing for certain vegetables. This is simply an application of fertilizer alongside rows of growing plants. This will ensure a supply of nitrogen as the plant grows and develops and is particularly beneficial in sandy garden soils or in seasons of abundant rainfall because nitrogen is often washed or leached out of the root zone area. Avoid getting fertilizer on the plant foliage.

To apply a sidedress material, make a small trench with a hoe or garden plow about four inches from the plant on both sides of the row and about one to two inches deep (see diagram). Scatter the fertilizer down the trench, cover with soil, and water, if possible. The fertilizer material may also be broadcast near the row and incorporated with a garden tiller.

Make the application at the right time. Side dress sweet corn when it is about 12 inches high, or about May 15; potatoes about May 15; and tomatoes after the first cluster has set. Side dress okra about three weeks after harvesting starts. Generally, use only one pound per 100 feet of row.

Summary

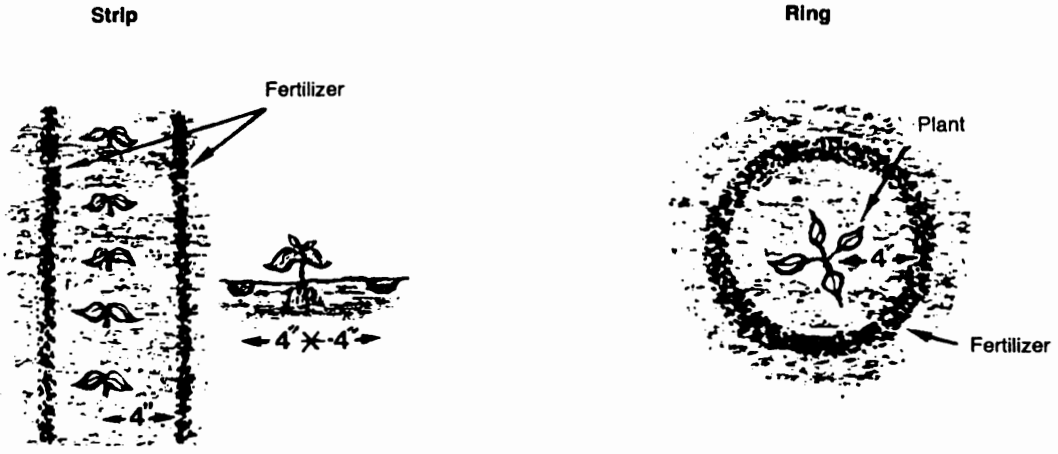
Fertilization is an important practice, but is not a cure-all for any gardening problem. Fertilization cannot compensate for:

1. Poor soil structure which does not allow for adequate drainage or aeration.
2. Undesirable soil pH or salt content of the soil.
3. Poor seeds or diseased or unhealthy plants.
4. Shade trees or tree roots in or around the garden areas.

During the winter before you begin to garden, you will want to get a sample of your garden soil tested to determine the pH and nutrient content. The soil test will tell you how much fertilizer you must add to your garden initially. It is then easier to maintain a high level of fertility as you garden year after year.

The addition of organic matter will add some fertilizer nutrients to the soil. You may need to add commercial fertilizer as well. Most chemical fertilizers are simply rock or mineral materials rich in nutrient elements.

Side Dressing Individual Plants and Garden Rows



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